US009279599B2

(12) **United States Patent**
Lee

(10) **Patent No.: US 9,279,599 B2**
(45) **Date of Patent: Mar. 8, 2016**

(54) **HEATING UNIT AND HEATING SYSTEM USING THE SAME**

(71) Applicant: **LITE-ON IT CORPORATION**, Taipei (TW)

(72) Inventor: **Yung-Lung Lee**, Hsinchu (TW)

(73) Assignee: **Lite-On Technology Corporation**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 296 days.

(21) Appl. No.: **13/950,225**

(22) Filed: **Jul. 24, 2013**

(65) **Prior Publication Data**

US 2014/0301726 A1 Oct. 9, 2014

(30) **Foreign Application Priority Data**

Apr. 7, 2013 (CN) 2013 1 0116992

(51) **Int. Cl.**

F24H 1/10	(2006.01)
F24H 3/04	(2006.01)
F24H 9/18	(2006.01)
H05B 3/26	(2006.01)

(52) **U.S. Cl.**

CPC ***F24H 3/0405*** (2013.01); ***F24H 9/1863*** (2013.01); ***H05B 3/262*** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,215,817	A *	11/1965	Peek	H05B 3/00 219/432
4,162,395	A *	7/1979	Kobayashi	F24H 3/0405 219/504
4,321,456	A *	3/1982	Ohnmacht	H05B 3/16 219/532
4,703,153	A *	10/1987	Pelonis	F24H 3/0417 219/505
4,717,813	A *	1/1988	Berg	H05B 3/141 219/202
5,028,763	A *	7/1991	Chung-Tai	H05B 3/30 219/505
5,125,070	A *	6/1992	Chung-Tai	H05B 3/30 219/505
5,202,547	A *	4/1993	Abe	B01J 35/0033 219/205
5,239,163	A *	8/1993	Brouwers	F24H 3/0405 165/185
5,243,683	A *	9/1993	Yang	A45D 20/12 165/183
5,377,298	A *	12/1994	Yang	H05B 3/148 219/504
5,452,181	A *	9/1995	Hoover	H01L 23/4093 165/80.3
5,521,357	A *	5/1996	Lock	H05B 3/262 219/541

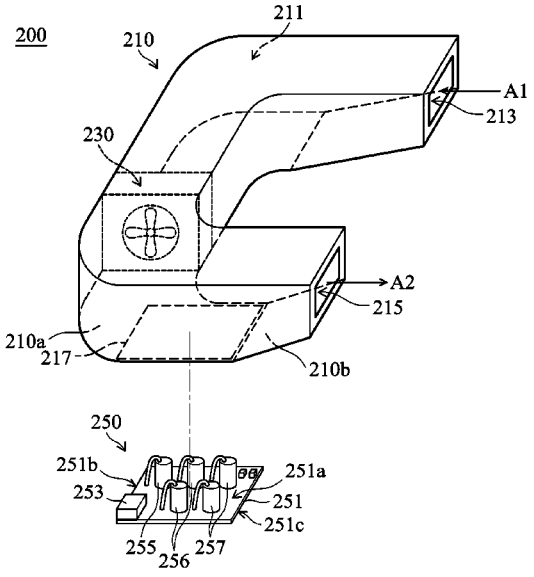
(Continued)

Primary Examiner — Thor Campbell

(57) **ABSTRACT**

A heating system is disclosed, which includes a main body having a duct formed therein, an air flowing guiding member, and a heating unit. The duct has an air inlet and an air outlet. The air flowing guiding member is disposed in the duct. The heating unit includes a substrate and a plurality of electronic components disposed on the substrate in a matrix form and embossed from a surface of the substrate, wherein each of the electronic components is capable of individually producing heat to directly heat up the air flowing in the duct. Also a heating system using the heating unit is disclosed.

12 Claims, 2 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

5,641,420 A * 6/1997 Peterson F24H 3/0405 219/536
5,665,261 A * 9/1997 Damsohn B60H 1/2225 219/202
5,805,767 A * 9/1998 Jouas G05D 23/1902 219/506
5,854,471 A * 12/1998 Tadokoro F24H 3/0429 219/505
6,172,343 B1 * 1/2001 Nothe H05B 1/0277 219/480
6,175,688 B1 * 1/2001 Cassidy A61M 5/44 392/470
6,285,004 B1 * 9/2001 Arold B60H 1/0005 165/41
7,977,607 B2 * 7/2011 Colette F24H 3/0405 165/148
8,637,796 B2 * 1/2014 Bohlender B60H 1/2221 219/202
8,948,582 B2 * 2/2015 Kominami F24H 9/20 165/175
9,029,740 B2 * 5/2015 Aguilar B23K 1/012 219/482
2002/0100753 A1 * 8/2002 Johnsgard H01L 21/67103 219/468.1
2002/0195441 A1 * 12/2002 Kariya H05B 3/12 219/466.1
2004/0020687 A1 * 2/2004 Moore H05K 1/0212 174/254
2004/0228646 A1 * 11/2004 Sekiguchi G03G 21/206 399/92
2007/0023411 A1 * 2/2007 Angelis B60H 1/00471 219/202
2007/0215329 A1 * 9/2007 Schwab H05K 7/20918 165/122
2008/0217324 A1 * 9/2008 Abbott C23C 4/06 219/538
2013/0180973 A1 * 7/2013 White H05B 3/28 219/209
2014/0355966 A1 * 12/2014 Pierron B60H 1/2221 392/360

* cited by examiner

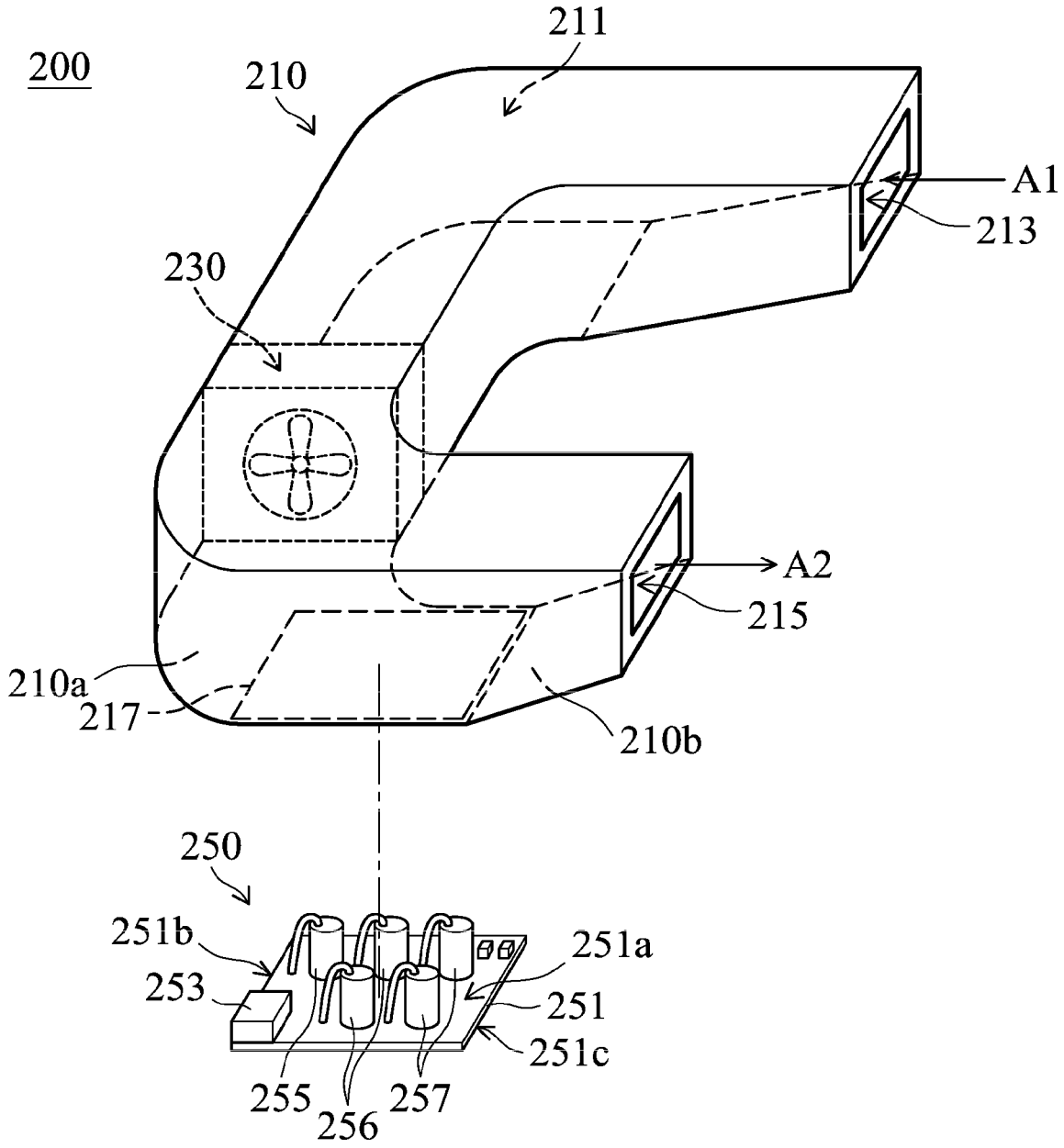

200
210
211
A1
213
230
A2
215
210a
217
210b
250
251b
253
251a
251
251c
255
256
257

FIG. 1

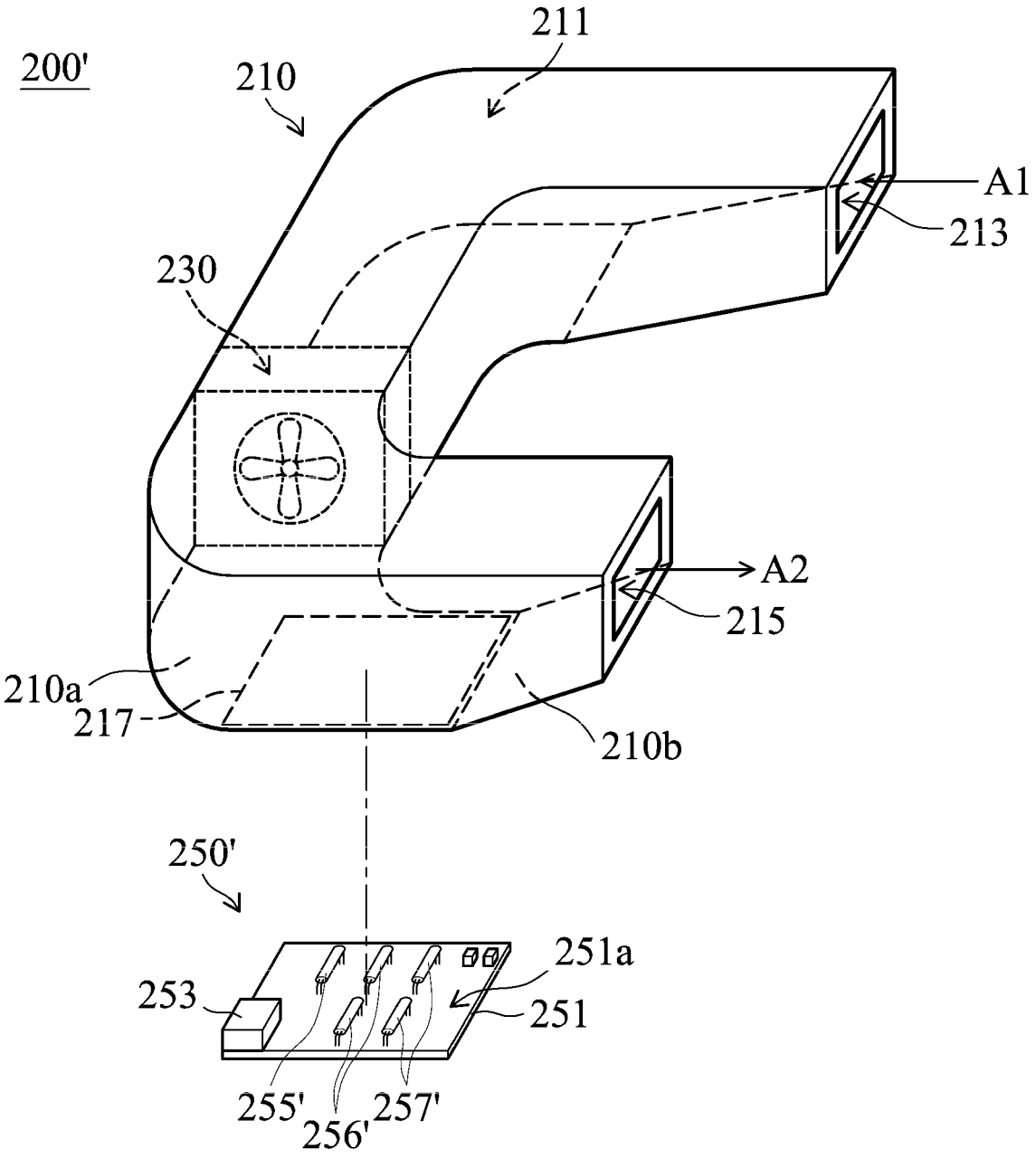

200'
211
210
A1
213
230
A2
215
210a
217
210b
250'
251a
253
251
255'
256'
257'

FIG. 2

HEATING UNIT AND HEATING SYSTEM USING THE SAME

CROSS REFERENCE TO RELATED APPLICATIONS

This Application claims priority of China Patent Application No. 201310116992.X, filed on Apr. 7, 2013, the entirety of which is incorporated by reference herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an electronic component of a heating system, and more particularly, to a heating unit of a heating system.

2. Description of the Related Art

In order to measure particular values to determine if a person is at risk of disease, the whole blood or serum of a human is reacted with a chemical reagent to perform chemical reactions in a medical apparatus. Since the chemical reaction and chemical activity are directly affected by reacting temperature, a temperature control system is required in the medical apparatus so as to improve accuracy of the measured values. Additionally, due to the fact that the normal environmental temperature, especially in a place where the medical apparatus is used, is below 37° C., a temperature control system is generally configured to produce heat to facilitate the chemical reaction.

The conventional temperature control system generally includes a resistive heating plate and heat dissipating fins which are formed by aluminum extrusion type. The heating plate may be formed by silicon resin, PET, high temperature stable mica, or polyimide film, and the heating plate is attached to a flat surface of the heat dissipating fins. While operating, heat generated from the heating plate is conducted to the heat dissipating fins and transferred to air that is to be heated. However, the temperature distribution on the heat dissipating fins is not uniform (the region near the heating plate has higher temperatures, and the region away from the heating plate has lower temperatures) thereby decreasing heat exchange efficiency.

Thus, a need exists for a heating unit which has high heat exchange efficiency and low manufacturing costs.

BRIEF SUMMARY OF THE INVENTION

In this regard, the disclosure provides a heating unit, in which a contacting area between the heating source and the air that is to be heated is increased so as to improve the heat exchange capacity in a unit volume of the heating system.

According to one embodiment of the disclosure, the heating unit comprises a substrate and a plurality of electronic components. The plurality of electronic components is disposed on the substrate in a matrix form and embossed from a surface of the substrate, wherein each of the electronic components is capable of individually producing heat to directly heat up air around the electronic components.

In the above embodiment, the substrate comprises a printed circuit board and has a first edge and a second edge opposite to the first edge, and the plurality of electronic components is arranged on the printed circuit board along a direction from the first edge to the second edge. Additionally, the plurality of electronic components has different heating powers, and along the direction from the first edge to the second edge the heating powers increase.

In the above embodiment, the plurality of electronic components has different heating powers, and along the direction from the first edge to the second edge the heating powers are adaptively adjusted according to heating requirements.

In the above embodiment, the plurality of electronic components is resistor elements and disposed on the substrate in an erected manner. Alternatively, the plurality of electronic components is disposed on the substrate in a lying manner

The disclosure also provides a heating system, which includes a main body having a duct, an airflow guiding member, and any one of the heating units.

In the above embodiment, the duct comprises a sidewall located between the airflow guiding member and the air outlet, and an opening is disposed on the sidewall, wherein the plurality of electronic components is disposed into the duct via the opening.

In the above embodiment, the substrate comprises a printed circuit board and has a first edge and a second edge, wherein the second edge is close to the air outlet relative to the first edge, and the plurality of electronic components is arranged on the printed circuit board along a direction from the first edge to the second edge.

In the above embodiment, the plurality of electronic components has different heating powers, and along the direction from the first edge to the second edge the heating powers increase.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

FIG. **1** shows an explosive view of a heating system of one embodiment of the disclosure; and

FIG. **2** shows an explosive view of a heating system of another embodiment of the disclosure.

DETAILED DESCRIPTION OF THE INVENTION

The following description is of the contemplated mode of carrying out the invention. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. The scope of the invention is determined by reference to the appended claims.

Referring to FIG. **1**, which shows an explosive view of a heating system **200** of one embodiment of the disclosure. The heating system **200** includes a main body **210**, an airflow guiding member **230**, and a heating unit **250**. The main body **210** has a hollowed duct **211**, and the duct **211** includes an air inlet **213** and an air outlet **215**. In the embodiment the main body **210** is a substantially U-shaped, and the air inlet **213** and the air outlet **215** are disposed on the same side of the heating system **210**. Namely, the air inlet **213** and the air outlet **215** are disposed on two ends of the U-shaped main body **210**. Additionally, as shown in FIG. **1** the main body **210** has an opening **217** disposed on a sidewall **210***a* located at a bottom side of the duct **211** adjacent to the air outlet **215**.

The airflow guiding member **230** is a fan assembly and disposed in the duct **211** for activating the air in the duct **211** to flow. As shown in FIG. **1**, a width of the fan assembly **230** is the same as that of a width of the duct **211** in a sectional direction, whereby enhancing the efficiency of the fan assembly **230**. It is appreciated that while in the embodiment the air guiding member **230** is a fan assembly, it should not be limited thereto. In other embodiments, the airflow guiding member may also include other devices such as a pump etc. to activate the air.

The heating unit **250** includes a substrate **251**, a connector **253**, and a plurality of electronic components **255**, **256** and **257**. In the embodiment, the substrate **251** is a printed circuit board. For the purpose of illustration, the printed circuit board **251** refers to the substrate in the following descriptions. The connector **253** is disposed in the printed circuit board **251** and connected to an external power source (not shown) to provide power for the plurality of electronic components **255**, **256** and **257**. The plurality of electronic components **255**, **256** and **257** is disposed on the printed circuit board **251** in a matrix form and embossed from a surface **251***a* of the printed circuit board **251**, wherein the electronic components **255**, the electronic components **256** and the electronic components **257** have different heating powers, respectively.

Specifically, as shown in FIG. **1**, the plurality of electronic components **255**, **256** and **257** is respectively resistor elements and disposed on the printed circuit board **251** in an erected manner, wherein the plurality of electronic components **255**, **256** and **257** is arranged on the printed circuit board **251** along a direction from a first edge **251***b* to a second edge **251***a* of the printed circuit board **251**. While assembling the heating unit **250** and the duct **211**, a surface **251***a* of the printed circuit board **251** where the plurality of electronic components **255**, **256** and **257** is disposed faces the duct **211** so as to allow the plurality of electronic components **255**, **256** and **257** to be inserted into the duct **211** via the opening **217**.

The operating method of the heating system **200** is illustrated hereinafter. To operate the heating system **200**, the connector **253** of the heating unit **250** is connected to an external power source (not shown) such that the plurality of electronic components **255**, **256** and **257** is capable of individually producing heat to directly heat up air around the plurality of electronic components **255**, **256** and **257**. Next, the airflow guiding member **230** is driven to activate the cold air flow A**1** flowing into the duct **211** via the air inlet **213** of the duct **211** and flowing through the plurality of electronic components **255**, **256** and **257** to exchange heat energy generated from the plurality of electronic components **255**, **256** and **257**. Then, the heated and warm air flow A**2** is exhausted via the air outlet **215** to an exterior of the heating system **200**.

Because the plurality of electronic components **255**, **256** and **257** is disposed on the printed circuit board **251** in an erected manner, the contact area between the plurality of electronic components **255**, **256** and **257** and the air flow is effectively increased whereby increasing heat exchange capacity. It is noted that with a decrease of the temperature difference between the plurality of electronic components **255**, **256** and **257** and the air flow, heat exchange efficiency decreases. In order to maintain heat exchange efficiency thereof, in the embodiment, the heating power of the electronic components **257** is larger than that of the electronic components **256**, and the heating power of the electronic components **256** is larger than that of the electronic components **255**. Thus, the temperature differences between the plurality of electronic components **255**, **256** and **257** and the air flow is maintained, and the air flow may be heated to a desired temperature. It is appreciated that the amount of the electronic components **255**, **256** and **257**, the arrangement of the electronic components **255**, **256** and **257**, and the variation of the heat powers of the electronic components **255**, **256** and **257** should not be limited to the embodiments. A person with average knowledge on this subject will be able to modify it according to demand.

Additionally, since the heating unit **250** is movably connected to the duct **211**, the heating unit **250** may be replaced by another heating unit with different heating powers or different configurations, such that the heating system is able to supply air flow at different temperatures without modifying the other elements and devices whereby decreasing manufacturing cost.

Referring to FIG. **2**, which shows an explosive view of a heating system **200'** of another embodiment of the disclosure, since elements similar with that of the heating system **200** shown in FIG. **1** are provided with the same reference numbers, thus, the features thereof are not reiterated in the interest of brevity. The heating system **200'** differs from the heating system **200'** in that the heating system **200** includes a heating unit **250'**, which includes a plurality of electronic components **255'**, **256'** and **257'** disposed on the printed circuit board **251** in a lying manner, such that the contact area between the plurality of electronic components **255'**, **256'** and **257'** and the air flow is effectively increased whereby increasing heat exchange capacity.

The heating system of the disclosure uses the resistor elements as heating sources so that the manufacturing cost of the heating system may decrease. Additionally, due to the fact that the heat energy generated from the heating unit is directly transferred to the air flow, no medium is necessary to conduct the heat generated from the heating unit to the air flow, and the heat exchange efficiency is improved. Moreover, compared with the conventional heating device which uses a resistive heating plate as a heat source, the heating unit of the disclosure is compatible to different types of heating systems with variant functions by adjusting the configuration of the heating unit.

While the invention has been described by way of example and in terms of preferred embodiment, it is to be understood that the invention is not limited thereto. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

What is claimed is:

1. A heating unit, comprising:

a substrate; and

a plurality of electronic components, disposed on the substrate in a matrix form and embossed from a surface of the substrate, wherein each of the plurality of electronic components is capable of individually producing heat to directly heat up air around the electronic components;

wherein the substrate comprises a printed circuit board which has a first edge and a second edge, and the plurality of electronic components is arranged on the printed circuit board along a direction from the first edge to the second edge; and

wherein the plurality of electronic components has different heating powers, and along the direction from the first edge to the second edge the heating powers are adaptively adjusted according to heating requirements.

2. The heating unit as claimed in claim **1**, wherein the plurality of electronic components is disposed on the substrate in an erected manner.

3. The heating unit as claimed in claim **1**, wherein the plurality of electronic components is disposed on the substrate in a lying manner.

4. The heating unit as claimed in claim **1**, wherein the plurality of electronic components is resistor elements.

5. A heating system, comprising:

a main body, having a duct with an air inlet and an air outlet;

an airflow guiding member, disposed in the duct and configured to activate air flow in the duct to flow; and

a heating unit, comprising:

a substrate; and

a plurality of electronic components, disposed on the substrate in a matrix form and embossed from a surface of the substrate, wherein each of the plurality of electronic components is capable of individually producing heat to directly heat up air flowing in the duct;

wherein the substrate comprises a printed circuit board which has a first edge and a second edge, wherein the second edge is close to the air outlet relative to the first edge, and the plurality of electronic components is arranged on the printed circuit board along a direction from the first edge to the second edge.

6. The heating system as claimed in claim **5**, wherein the duct comprises a sidewall located between the airflow guiding member and the air outlet, and an opening is disposed on the sidewall, wherein the plurality of electronic components is disposed into the duct via the opening.

7. The heating system as claimed in claim **5**, wherein the plurality of electronic components has different heating powers, and along the direction from the first edge to the second edge the heating power of each of the plurality of electronic components increases.

8. The heating system as claimed in claim **5**, wherein the plurality of electronic components has different heating powers, and along the direction from the first edge to the second edge the heating powers are adaptively adjusted according to heating requirements.

9. A heating unit, comprising:

a substrate; and

a plurality of electronic components, disposed on the substrate in a matrix form and embossed from a surface of the substrate, wherein each of the plurality of electronic components is capable of individually producing heat to directly heat up air around the electronic components;

wherein the substrate comprises a printed circuit board which has a first edge and a second edge, and the plurality of electronic components is arranged on the printed circuit board along a direction from the first edge to the second edge; and

wherein the plurality of electronic components has different heating powers, and along the direction from the first edge to the second edge the heating power of each of the plurality of electronic components increases.

10. The heating unit as claimed in claim **9**, wherein the plurality of electronic components is disposed on the substrate in an erected manner.

11. The heating unit as claimed in claim **9**, wherein the plurality of electronic components is disposed on the substrate in a lying manner.

12. The heating unit as claimed in claim **9**, wherein the plurality of electronic components is resistor elements.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,279,599 B2
APPLICATION NO. : 13/950225
DATED : March 8, 2016
INVENTOR(S) : Yung-Lung Lee

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

ON THE TITLE PAGE

Item (71)

Applicant should read: Lite-On Technology Corporation, Taipei (TW)

Signed and Sealed this
Thirty-first Day of May, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office